Projectile Fragmentation in Pb+Pb Collisions at 158 A·GeV

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The fragmentation of the projectiles in Pb+Pb collisions at 158 A·GeV at the CERN SPS is studied in order to determine how many spectator nucleons are bound in fragments as a function of centrality. This is accomplished by measuring the forward-going energy in the NA49 zero-degree calorimeter (called Veto calorimeter) in conjunction with the adjustable iron collimator, which defines the acceptance of the calorimeter. NA49 uses two superconducting dipole magnets with a total bending power of 7.8 T·m. Since the spectator nucleons in the projectile fragmentation region have approximately the beam energy and small p_T, the deflections of nucleons and fragments in the bending plane depend mostly on their charge-to-mass ratios. (The amount of deflection of spectator protons is 30 cm at the collimator.) Thus, neutrons, protons, and fragments of the spectator matter can be disentangled and measured separately in the Veto calorimeter.

The centrality trigger is provided by the NA49 Ring calorimeter (positioned upstream of the collimator and the Veto calorimeter) which measures energy deposited near mid-rapidity in each event. By comparing the data with the prediction of VENUS, the impact parameter was deduced. Forward energy data were taken in 1995 and '96 with appropriate configurations of the collimator in four separate runs to measure 1) neutrons only, 2) protons only, 3) fragments only, and 4) all three simultaneously. To estimate the amount of background contamination, a target-out run was also performed.

The magnitude of the contamination in the Veto calorimeter signal from showers that originate in the collimator and reach the Veto calorimeter, as well as from produced particles, is estimated using GEANT simulation. A fraction of the spectator nucleons in VENUS are assigned to fragments such that the full-physics GEANT simulation for the neutron configuration resembles the neutron data. This procedure was reiterated until the results of all configurations roughly fitted the respective data sets. The corrections for these effects were applied to the data.

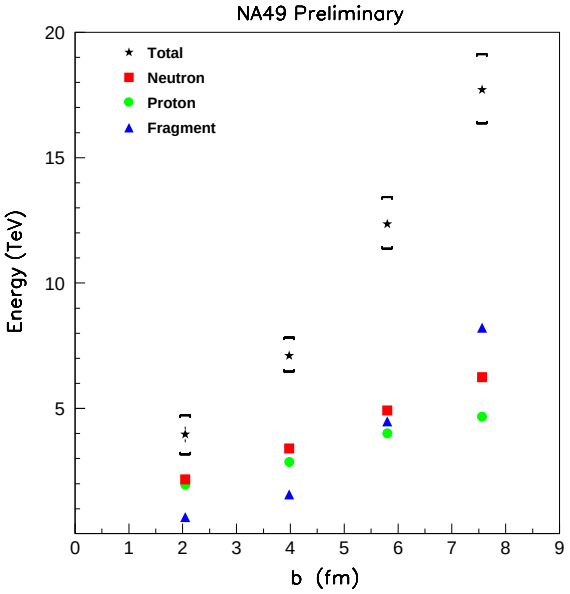

Figure 1: Projectile spectator energy as a function of the impact parameter. The square brackets are the estimated systematic errors.

Fig. 1 shows the energy carried by spectator neutrons, protons and fragments as a function of the impact parameter. The sum of energies carried by neutrons, protons and fragments agrees with the total energy to within the systematic uncertainties. These data, however, have not been corrected for the small non-uniformity of the Veto calorimeter. This correction will slightly affect the relative energy calibration of protons and neutrons. We observe that the energy carried by fragments is small for central collisions but increases dramatically for larger values of b. The final analysis of these data is in progress.